

Element D Services

Heating, Ventilating, and Air
Conditioning

D3035 Chillers and Associated Equipment

PART 1 - GENERAL

1.1 OVERVIEW

- A. For projects requiring new or modified chilled water systems, this section includes criteria for the design of air-cooled and water-cooled chillers including cooling towers, valves and specialties.

PART 2 - DESIGN CRITERIA

2.1 GENERAL

- A. All chillers shall comply with ASHRAE Standard 147, for Reducing Emission of Fully Halogenated Chlorofluorocarbon Refrigerants, addresses refrigerant emission reduction practices in manufacturing, design, installation and servicing of equipment.
- B. Where possible, in locations with simultaneous heating (HVAC heating or domestic hot water) and cooling loads are present, new chillers and similar refrigeration equipment are to utilize heat recovery systems to serve heating/re-heating loads. Heat recovery using de-superheaters, heat recovery barrels, elevated condenser water temperatures, heat pump chiller operation, and/or other opportunities is to be pursued. Recovered heat is to be used for HVAC heating, domestic hot water heating, and low temperature desiccant regeneration. HVAC heating water in such systems shall use low temperature supply/return components/configurations to allow for maximum reuse of waste heat. Refer also to Design Guideline Element DG D3044.
- C. During periods when the chilling system is operating with the outdoor wet bulb temperature below design, condenser water supply temperature setpoint is to be reset to track the cooling tower's wet bulb temperature approach line prescribed by the cooling tower manufacturer. During condenser water supply reset periods, chiller minimum condenser water supply temperatures (and minimum pressure differentials between evaporators and condensers) shall be respected to prevent surging of refrigeration machines. Intent is reduce chiller lift and compressor head pressures during periods when outdoor wet bulb temperature is below design values. Strategy is not applicable when in heat recovery modes unless dual condenser barrels or other heat recovery vessels are utilized.
- D. For new and existing facilities with evaporative cooling towers, use cooling coil condensate recovery for cooling tower make-up. Intent is to reduce potable water use and chemical treatment of evaporative cooling make-up water, while reducing sewage treatment of condensate. Confirm application of condensate reuse with Project Program requirements. Refer also to Design Guideline Element DG D3041.
- E. For a new chilled water plant, select a minimum of two chillers identical in size and design. If anticipated part-load conditions or energy recovery applications justify chiller selection of uneven sizes, the A/E shall prepare a cooling load profile to demonstrate selection of chiller sizes. Identify where chiller(s) are used in heat recovery and heat pump applications.

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- F. For building renovation projects, a single chiller may be used if the system can be cross-connected to an existing chiller plant. Confirm with Owner.
- G. Chiller replacements that are part of an existing building renovation project shall comply with state code requirements pertaining to mechanical rooms that have existing chillers and boilers in the same room with no physical barriers between them. Provisions shall be made during design to either separate the equipment or provide controls that interlock the boilers with a refrigerant monitoring device.
- H. For chillers located inside mechanical equipment rooms, the refrigerant monitoring system shall comply with State requirements. The monitoring system shall include the requirements and the correct locations of audiovisual alarms. Provisions shall be made at chiller mechanical room exits for emergency shut down of equipment and for chillers not having Group A1 or B1 refrigerants.
- I. All refrigerant safety relief devices or rupture disk on refrigeration equipment located within a building shall be piped and routed outside of the building, at locations not less than 15 feet above adjoining grade level and not less than 20 feet from any windows, ventilations, openings, or exits.
- J. Provide emergency chilled water flanged piping connections covered with blind flanges and isolation valves for emergency chilled water service. If the chillers are water-cooled units, provide emergency condenser water service connections in addition to chilled water connections.
- K. Provisions shall be made to accommodate high velocity flushing of main piping and distribution loops.
- L. The selection of a specific refrigeration chiller design requires careful analysis. The following parameters should be considered when determining what type of chiller to use.
 - 1. Life Cycle Cost Analysis of different types of chillers.
 - 2. Size in Capacity (kW or Tons of Refrigeration).
 - 3. Application of service.
 - 4. New System or Addition to Existing System.
- M. All chillers including air or water cooled, with reciprocating, scroll, rotary screw, centrifugal compressors and direct or indirect fired absorption units, shall meet or exceed the required minimum efficiency per the applicable tables in the latest state edition of ANSI/ASHRAE/IESNA Standard 90.1.
- N. When designing air cooled chillers, use scroll chillers for 20-200 ton applications and rotary screw chillers for 200-500 ton applications. Implement sound reduction options in specifications when the project requires. Consult with owner and sound consultant.
- O. Chiller staging is recommended on loads greater than 300 tons to take advantage of part-load efficiency. Sequence chillers to meet demand requirements so that each chiller

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operates at its most efficient part-load.

- P. Pump head calculations shall be based on the actual designed piping layout shown on the construction drawings. Add an additional 10 percent safety factor to the final results of the calculation.
- Q. Condenser and chilled water piping (where marine water boxes are not specified or used) shall be fabricated into removable spool piece sections to permit easier access to tube bundles in the condenser and evaporator sections.
- R. When laying out equipment, provide ample space to service and repair equipment. The tube pull space shall be clearly shown on the Drawings.
- S. For water cooled chillers, air-conditioning for mechanical rooms shall be sized assuming the chillers will all have open drive motors and the specification shall allow both open and non-open drive motors.
- T. For new chiller plant construction, provide a designated space, shown on the Drawings for a future chiller(s), equal in size to the largest machine being furnished. Space planning should also be considered with associated pumps, cooling tower, and other equipment to support additional chillers.
- U. Cooling tower blowdown drains are to be routed to sanitary drains, and the catch basins shall be sized for the proper capacity to manage surge flow conditions from peak cooling tower blowdown to avoid overflow conditions.
- V. Elevated cooling towers require stairs and platforms, and access door ways to reach areas outside and within the tower fill area for operation, and maintenance.
- W. Cooling tower basin water level controls are to be provided for each individual cooling tower cell and basin isolation gates are to be provided between combined tower cells to permit maintenance to be performed on one tower cell while the adjacent cell is in operation.
- X. Emergency power shall be available to the required quantity of chillers deemed to be necessary to support special ventilation environments for all Patient Care (medical) Facilities, Laboratory, or Vivarium areas where required. Refer also to Section D3000 for additional emergency power requirements.
- Y. Refrigeration machinery rooms shall be mechanically ventilated (exhausted) to the outdoors. Mechanical ventilation shall be capable of exhausting the minimum quantity of air both at normal operating and at emergency conditions per IMC. Duct intakes of the mechanical exhaust shall be located within 6 inches above the lowest floor level of the room.

PART 3 - SPECIAL CONTRACT DOCUMENT REQUIREMENTS

3.1 GENERAL

- A. Specify that all shop drawings must be submitted in AutoCAD format.
- B. A schematic diagram shall have the entire chilled water and cooling tower water systems (if

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water cooled) including controls shall be shown on a drawing. The diagram shall be complete with, but not limited to the following:

1. Temperature Sensors
2. Control Valves
3. Pressure Differential Assemblies
4. Expansion or Compression Tanks
5. Air and Dirt Separators
6. All valves and piping specialties
7. Water filters
8. Chemical feeders
9. Water treatment system for cooling tower(s)
10. Make up water connection
11. Cooling tower make up and blowdown meters
12. HVAC condensate recovery (where applicable)
13. Cooling tower basin sediment removal/filtration system(s)
14. Variable speed drives
15. Flow control and measuring devices
16. Primary, and secondary pumps
17. Chillers
18. Plate and frame heat exchangers

C. The following sensors shall be required and connected to the BAS as a minimum:

1. Flow meter for each chiller chilled water
2. Temperature sensor on supply and return for each chiller
3. Flow meter on total plant flow unless it would be redundant to total building flow
4. Supply and return temperature sensors on total plant
5. Flow meter on condenser water supply to chillers
6. Flow meter on plant bypass if applicable

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PART 4 - PRODUCTS

4.1 GENERAL

- A. Refer to Owner's Master Construction Specifications. These are available on the Owner's Design Guidelines website:
<http://www2.mdanderson.org/depts/cpm/standards/specs.html>
- B. If hot water reheat coils are being used on a HVAC air distribution system and considerable air conditioning load is occurring year round, the A/E needs to evaluate the use of a chiller that is capable of performing as a heat recovery unit.
- C. If the maximum cooling tower tonnage is at or near the capacity limit of a selection, then choose the next larger size of tower; the increase in capacity will add some safety factor to equipment sizing. This added safety factor will reduce energy cost by providing a larger interface area between the water and air, which, through the use of a variable frequency drive will decrease the fan horsepower required for a given tonnage. Every effort should be made to accommodate a propeller fan tower to avoid the energy penalty associated with centrifugal blowers.
- D. Provide or consider/pursue automatic cold water basin sediment removal system and filtration for evaporative cooling towers. Intent is to reduce cooling tower maintenance, increase longevity, and reduce chemical water treatment (biocides).
- E. Specify power operated tight, shut off butterfly type valves to isolate the condenser water and chilled water at the inlet and outlet connections.
- F. Specify pre-insulated chilled water piping for underground piping.
- G. Use horizontal split case pumps for primary and secondary chilled water systems and condenser water systems where applicable. Vertical split coupling inline pumps may be used when space is limited.

PART 5 - DOCUMENT REVISION HISTORY

Issue	Date	Revision Description	Reviser
	20190301	Initial Adoption of Element	
Rev. 1			

END OF ELEMENT D3035